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Research Article

Epistemological beliefs in mathematics teacher educators: An exploratory study in Chile

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In Chile, mathematics results are insufficient at the school level. To address this problem, the need to rethink teaching has been raised. Evidence indicates that epistemological beliefs are at the basis of pedagogical decisions, and their study has been developed mainly in primary and secondary school teachers. However, scientific evidence is scarce regarding this belief in teacher educators. To fill this knowledge gap, this study aims to analyze the epistemological beliefs in mathematics teacher educators' discourse. This research was developed using a qualitative approach. Seven teacher educators participated, and data was collected through a semi-structured interview. In the discourse of the teacher educators, a developed tendency is observed in each dimension of their epistemological beliefs. However, links between this type of belief and some specific context characteristics are noticed. It is suggested that spaces for dialogue and reflection within the academic staff be implemented to analyze their epistemological beliefs and promote their development among future teachers.

Keywords: Higher education; Mathematics education; Teacher educators; Teacher education; Teaching

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1. Introduction

Internationally, the teaching of mathematics occupies an essential place in the school curriculum (Wang et al., 2023). Currently, systematized scientific evidence reveals that mathematics generates profound implications in the cognitive development of children and youth (Robinson et al., 2023; Wilson et al., 2024). Also, it has been found that mathematics at the school level promotes the development of 21st-century skills, such as critical thinking, problem-solving, and collaborative work (Rehman et al., 2023). However, the COVID-19 pandemic generated negative consequences in the achievement of this learning, which has prompted various agencies and educational institutions to seek strategies to remedy this situation (Engelbrecht et al., 2023).

In Chile, evidence reveals that during the last 20 years, there have been no significant improvements in mathematics outcomes at the school level (Mena, 2022). Public policy has taken up this challenge, and in 2021, new "Pedagogical and Disciplinary Standards" were enacted to strengthen the initial training of mathematics teachers in secondary education (Centro de Perfeccionamiento e Investigaciones Pedagógicas [CPEIP], 2021). Evidence indicates that the work of teachers is the main factor in student performance and having a highly trained teaching staff has become a priority to improve educational outcomes (Bastías-Bastías & Iturra-Herrera, 2022).

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One of the main aspects of this public policy is that it seeks to promote the transition from a pedagogical model centered on the teacher and the contents to a model whose focus is the student and their learning (CPEIP, 2021). According to the findings reported by Treviño et al. (2019), unidirectional and expository teaching practices prevail in Chilean classrooms, focused on the transmission of content, the execution of repetitive procedures, and exposure to tasks with low participation and cognitive demand for students, which explains to some extent the learning results obtained. The same authors point out that teachers' beliefs could constitute an obstacle to implementing student-centered strategies by finding that they implicitly guide their teaching practices (Treviño et al., 2019).

Considering the results of the study by Treviño et al. (2019), it seems pertinent that public policy should focus its efforts on initial teacher education since it is in this context that future teachers would question and develop their beliefs early, preparing them to successfully face the challenges that teaching currently implies (Avalos, 2018). However, little has been discussed about the role of teacher educators in this regard since they are the most responsible ones for implementing the reforms and innovations proposed to improve teacher education programs (Bouckaert & Kools, 2017). Nevertheless, considering this background, their epistemological beliefs should be aligned with the didactic pedagogical turn proposed by this new public policy.

However, there is little evidence of the epistemological beliefs of teacher educators. At the international level, a study by Khan et al. (2020) in different higher education institutions found that, although developed and undeveloped beliefs coexist in this group of professionals, the latter are more frequently reported. If future teachers are expected to manifest a developed tendency of this belief, this situation would constitute a problem. In Chile, some studies have been carried out addressing this belief in future teachers (Schommer-Aikins et al., 2012) and in primary and secondary school teachers (Guerra & Sebastián, 2015). However, to date, there is no scientific evidence of the epistemological beliefs of Chilean teacher educators.

Based on the background presented, this study aims to analyze the epistemological present beliefs in the discourse of teacher educators in the didactic area of mathematics. The relevance of this research is justified mainly by three aspects. First, in Chile, the evidence points out the low mathematics results at the school level (Mena, 2022). Therefore, it is essential to strengthen the teaching processes. Second, epistemological beliefs become a didactic framework that guides teachers' pedagogical decisions and strategies (Schommer-Aikins, 2004). Therefore, promoting their development and moving towards a student-centered pedagogical model is crucial. Third, the study of teacher educators is still incipient in the Chilean context (Gómez, 2019). Consequently, this work represents an original and novel contribution to this field of study.

2. Theoretical Framework

2.1. Epistemological Beliefs

In the framework of research on teacher thinking, the study of beliefs has gained particular relevance during the last decades (Fives & Buehl, 2016; Garritz, 2014; Lee et al., 2017; Pajares, 1992). Different studies have shown a close connection between educators' individual beliefs and their work as teachers (Cortez et al., 2013; Lonka, 2018; Pozo, 2017; Rodríguez-Sosa & Solis-Manrique, 2017). Epistemological beliefs, in particular, refer to people's beliefs about knowledge and the process of knowing (Hofer & Pintrich, 2002).

Schommer-Aikins (2004) was one of the first researchers to conceptualize this type of belief. For this, she created a multidimensional system made up of five dimensions: structure, stability, and certainty of knowledge, as well as ability and speed to know. For this author, each dimension of epistemological beliefs is independent and moves from an undeveloped or naive pole to a developed or sophisticated pole. Table 1 presents a synthesis of this model.

Table 1
Schommer's model of epistemological beliefs

Dimension	*Epistemological belief undeveloped (naive)*	*Epistemological belief Developed (sophisticated)*
Knowledge structure	Knowledge is simple and consists of separate data.	Knowledge is complex and is made up of linked data.
Stability of knowledge	Knowledge is stable, it does not change.	Knowledge is dynamic and changing.
Source of knowledge	Knowledge is transmitted by a superior or expert.	Knowledge comes from reason; it is built collectively and personally.
Ability to know	The ability to know is not developed.	The ability to know is developed.
Speed to know	Knowing happens quickly, or it does not happen.	Knowing is a process that occurs gradually.

Note. Own elaboration based on Schommer-Aikins (2004).

In concrete terms, teachers with naïve epistemological beliefs would not establish links between contents, approach them in a fragmented manner, work with little updated knowledge, and have a transmitting role of knowledge. Likewise, they would not strive to promote diverse learning experiences and would expect knowledge to be assimilated quickly (Leal, 2011). On the contrary, teachers with sophisticated epistemological beliefs would approach content linked, constantly updating their knowledge, building spaces for dialogue and reflection, seeking diverse alternatives to develop the ability to know, and gradually working knowledge (Leal, 2011).

Internationally, the study of these types of beliefs and their relationship with teaching practice has been developed mainly among primary and secondary school teachers (Aguilar-Valdés et al., 2024). The results of these investigations highlight the practical implications of the development of epistemological beliefs in predicting the teaching approach teachers use (Ardic & Uslu, 2021; Yousefzadeh & Babapour, 2015). Teachers with sophisticated epistemological beliefs tend to adopt a constructivist perspective in the classroom through tasks that promote autonomy, dialogue, and the active participation of students in the construction of their knowledge (Leng et al., 2018; Üztemur et al., 2020). In contrast, teachers with naïve epistemological beliefs hold a traditional view of the educational process, mainly using strategies focused on the passive transmission and reception of content (Aldossari & Al Khalidi, 2021; Milutinović & Anđelković 2018).

Research points out that practicing teachers hold sophisticated epistemological beliefs in their discourse (Aldossari & Al Khalidi, 2021; Lammassaari et al., 2021; Leng et al., 2018; Milutinović & Anđelković, 2018; Üztemur et al., 2020; Yousefzadeh & Babapour, 2015). However, other studies warn that these beliefs are inconsistent with their teaching practices, showing the influence of some factors involved in implementing student-centered strategies, such as the age of teachers, the social characteristics of the school context, and the skills and behavior of students. Another critical aspect to highlight is the work culture in the educational establishment, which sometimes focuses mainly on evaluation and competence, contributing to the development of a transmissive logic of teaching (Aguilar-Valdés et al., 2024; Aldossari & Al Khalidi, 2021; Ardic & Uslu, 2021; Sengul et al., 2020; Sun, 2017).

Studies in Chile reveals that sophisticated epistemological beliefs prevail in primary and secondary school teachers (Arredondo & Rucinski, 1996). However, another research shows that they vary according to the formative level, finding that secondary school teachers have more sophisticated beliefs than primary school teachers (Guerra & Sebastián, 2015). Studies developed with student teachers show similar developmental states depending on the teaching level (Mejía & Palma, 2004). Likewise, a more significant development of epistemological beliefs is observed as they advance in their initial teacher training (Leal, 2005; Schommer-Aikins et al., 2012).

2.2. Teacher Educators and Mathematics Teacher Educators

The quality of teachers is closely related to their experience during their initial teacher training and, specifically, the teaching they receive from their teacher educators (Gómez, 2019). Internationally, research on the skills, knowledge, and strategies teacher educators use is becoming increasingly relevant (Ping et al., 2018). The literature points out that the composition of academic staff has developed autonomously and intuitively by incorporating professionals with diverse backgrounds (Kelchtermans et al., 2018; Montenegro, 2016).

To develop their work, teacher educators must constantly link the pedagogical knowledge cores with the discipline's knowledge (Murray & Male, 2005). This particularity generates that the professional identity of the teacher educator must be understood as a different modality from that of the school classroom teacher since he/she must adapt his/her teaching strategies to deliver didactic and disciplinary guidelines (Allen et al., 2016; Loughran, 2014; Russell & Loughran, 2007). In addition, teacher educators implicitly model their beliefs, values, and practices, an essential aspect of their work that has yet to be problematized (Boyd, 2014; Loughran & Berry, 2005; Lunenberg et al., 2007).

Mathematics teacher educators have a fundamental role in the formative experience of future teachers (Coles & Helliwell, 2023). Internationally, the literature agrees that their work strongly impacts the pedagogical and disciplinary knowledge of students entering mathematics teacher education programs in secondary education (Beswick & Goos, 2018). In a study developed by Hauk et al. (2017), the authors point out that although mathematics teacher educators often have a deep disciplinary background, they face challenges that conflict with them when teaching. For Olanoff et al. (2021), this problem is manifested by the lack of teaching experience in the school context and the limited opportunities to reflect on teaching and learning.

In Chile, a similar problem was detected during the initial training of mathematics teachers. Specifically, the need to incorporate educators specialized in mathematics methods has been expressed since deep theoretical training prevails to the detriment of pedagogical aspects, triggering a series of difficulties for novice teachers when inserted into the school context (Pino-Fan et al., 2018). On the other hand, it has been proven that the generation of support measures and support for the work of mathematics teacher educators promotes positive changes in teaching strategies (Radovic et al., 2018). However, expanding roles and demands within teacher education programs often mitigate the possibility of these transformations in the university classroom (Radovic et al., 2018).

3. Methodology

3.1. Research Design

The objective of this study is to analyse the epistemological beliefs that are present in the discourse of mathematics teacher educators; in this study, we consider mathematics teacher educators as those who teach courses associated with teaching and learning math inside teacher education programs. This research is supported by an interpretive paradigm, assuming that subjects construct their epistemological beliefs as historical, social and cultural subjectivities (Denzin & Lincoln, 2017). This perspective was chosen as it establishes a close link with experience, enriching the interpretation of this phenomenon in its natural and local context (Creswell & Creswell, 2018). In addition, it grants greater depth and relevance to the situated and cultural character of beliefs (Gaete et al., 2018).

A qualitative approach was implemented since it allows for studying highly complex phenomena from a flexible, systematic, and recurrent perspective of emerging regularities (Flick, 2018). Considering that the evidence reported by the literature at the national and international levels is scarce around epistemological beliefs and their relationship with teaching (Aguilar-Valdés et al., 2024), this work acquires an exploratory and preliminary character regarding the participants involved, the approach and the data gathering used. This type of research is characterized by an iterative and flexible approach to advance in trends that allow us to delve into

new problems, identify promising dimensions, and raise suggestions for future research (Creswell & Creswell, 2018).

3.2. Participants

Participants were selected using the multiple "snowball" technique (Flick, 2018). Three mathematics teacher educators from different universities were contacted and selected through convenience sampling (Moser & Korstjens, 2018). In turn, these mathematics teacher educators contacted other potential participants, with the aim of achieving a heterogeneous and diverse sample of teacher educators. In total, seven teacher educators from method courses participated. This specific area was chosen because it deals with mathematics' pedagogical and disciplinary aspects. All the participants belonged to secondary mathematics teacher education program located in different universities in the central-southern zone of Chile. Two had a doctoral degree, and five had a master's degree (see Table 2). The final sample size was defined under the theoretical saturation criterion (Moser & Korstjens, 2018). That is, data collection was stopped when the accounts of new participants did not provide a different and relevant background for the study than the proposals of the first participants. The analytical process began after the second interview; therefore, this strategy informed us of the preliminary findings between the interviews.

Table 2
Characteristics of the sample

Participant	*Qualifications*	*University*	*Years as a teacher educator*
TE1	Master's degree	University 1	11
TE2	Doctorate degree	University 1	10
TE3	Master's degree	University 2	1
TE4	Doctorate degree	University 2	25
TE5	Master's degree	University 3	12
TE6	Master's degree	University 3	7
TE7	Master's degree	University 3	2

3.3. Data Collection Process

Semi-structured interviews were conducted for data collection (Kvale, 2011). This sensitive and spontaneous technique allows for the interpretation of perceptions, meanings, and beliefs (Kvale, 2011). In addition, it involves an interactive process with the participants, generating a space of trust for participants to express the ideas they have constructed from their own experiences (Creswell & Poth, 2017). The first author conducted the interviews between August and November 2022. The Zoom platform was used because of health restrictions (COVID-19 pandemic). Each teacher educator read and signed an informed consent form in which they freely and voluntarily agreed to participate in this study.

The interview protocol included two vignettes, which were read together with the participant at the beginning of the interview (see Table 3). Subsequently, several questions about the case were asked to explore the participants' epistemological beliefs (see Table 4). To ensure the appropriateness for the research topic, the accuracy, and alignment of the vignettes and semi-structured interview questions were validated by two expert judges in the field of mathematics education (Boateng et al., 2018).

Vignettes are brief and fictitious stories that can be presented in an iconic or written form (Ceballos-López & Saiz-Linares, 2021). Their use has become widespread in recent years in qualitative research as a novel and valuable alternative, especially when addressing complex topics such as beliefs (Sampson & Johannessen, 2020). In this case, both stories presented fictitious situations related to the role of teacher educators and the teaching of the discipline in initial teacher training. These stories were developed by the authors based on classroom cases presented by Reyes (2011), in which different teaching experiences were recounted to be analyzed by

students in teacher education programs. In engaging with these vignettes, participants evaluate their teaching decisions and practices based on examples from their experiences. The first vignette involved a disciplinary focus (mathematical modeling) and described a scenario wherein a teacher educator's decision and the advice she received from her colleague to teach a specific topic (quadratic functions), questioning its usefulness and effectiveness. The second vignette had a pedagogical focus (teaching strategy) and dealt with a teacher educator who had received adverse comments regarding the methodology used in his classes (group work).

Table 3
Vignettes

Case	*Vignettes*
Case 1	Claudia is starting her career as a teacher educator in a Mathematics teacher education program. Due to her studies and experience, she was offered to teach the Algebra course, part of the first year of the curriculum. To resolve some doubts and gather her colleagues' experience, she consulted Diego, a teacher educator she knew, about the methodological strategy he has used to work with teachers in training on quadratic functions. Claudia tells him that she would like to work using mathematical modeling together with an analysis to deduce the characteristics of a quadratic function since, in this way, she would be enriching the understanding of the content with examples of everyday experiences. Diego tells her that last year he was in charge of working on that topic and that he mainly dealt with conceptual and procedural aspects of quadratic functions because he had many difficulties integrating modeling. In fact, when he finished the course, in the teacher survey, the students told him that the content they learned the least was modeling. After listening to her colleague, Claudia doubted how to work with this content.
Case 2	Gonzalo has been working in a Mathematics teacher education program for seven years and is constantly looking for ways to generate different teaching strategies for each subject he is teaching. In the last Geometry class, he addressed the similarities of plane figures, forming groups and giving them a work guide. Each group had to propose a solution to the problem presented in the document. However, at the end of the session, some students approached him to comment that the work method did not suit them since only some of them participated in the activity. Very concerned about this comment, he sought help and talked to Carolina, a teacher educator who has been working in the course for over fifteen years. After explaining what had happened, Carolina commented that the same thing happened to her. She suggested that he avoid group work and look for alternatives that would generate more active student participation. In the next class, Gonzalo uses an individual work guide, which the students finish before the end of the session. As they left the room, two students told him that they loved the class since they had learned a lot about the topic he taught.

Table 4
Semi-structured interview script

Case	*Guiding questions*
Fist case	What do you think of the situation that arises in this case? What would you have done? What would you recommend to Claudia? How would you introduce and link mathematical modeling to the disciplinary training of future teachers? How would you work on modeling skills in future teachers? What teaching strategies would you use?
Second case	What do you think of the situation presented in the case? Have you experienced something similar? What is your experience with students working collaboratively? Should collaborative work be installed as a fundamental strategy in initial training? How would you link collaborative work with the disciplinary training of future teachers? How do you teach similarities of plane figures to future teachers?

3.4. Data Analysis

Each interview was analysed by reflexive thematic analysis (Braun & Clarke, 2019), through a flexible and iterative process. This type of analysis is helpful for interpretive studies, a product of its reflexive nature that highlights the role of the researcher as an active agent, conscious and sensitive to his or her decisions. However, it requires the researcher to continuously withdraw and question his or her assumptions so that the results reflect the intersection between the data, the analytical process, and subjectivity (Braun & Clarke, 2019). Furthermore, this type of analysis is beneficial for analyzing people's beliefs, considering their complex and experiential nature.

The coding process was developed using ATLAS.ti7® software. Specifically, the interviews were coded by analysing the five dimensions of the Schommer-Aikins (2004) model of epistemological beliefs. To do so, we create a specific code for each dimension of Schommer's model of epistemological beliefs. In addition, four emergent codes were identified related to obstacles perceived by teacher educators between their sophisticated epistemological beliefs and their teaching practices. To safeguard the quality of this procedure, the study's authors thoroughly and exhaustively performed at least three readings of each document, coding relevant extracts so that the themes were coherent, consistent, and different from each other. The coding involved review and triangulation between both researchers, mitigating the bias from an individual analysis and broadening the interpretive gaze (Korstjens & Moser, 2018).

4. Results

The data analysis identified the five dimensions of the Schommer-Aikins (2004) model of epistemological beliefs. Likewise, the analysis identified other dimensions related to specific context characteristics linked to this type of belief and its relationship with teaching practice. However, to protect the participants' anonymity and confidentiality, the extracts' authorship has been identified with a letter and a consecutive number (TE1: teacher educator one; TE2: teacher educator two; etc.).

4.1. Epistemological Beliefs of Mathematics Teacher Educators and their Relationship with Teaching

In general terms, the participants' discourse shows a sophisticated trend in their epistemological beliefs related to the five dimensions proposed by the Schommer-Aikins model (2004). For example, concerning the knowledge source dimension, participants point out their relevance to collaborative work as a strategy that favors the construction of knowledge through individual discovery and group discussion. In other words, they visualize knowledge generated through dialogue and the construction of agreements involving shared and personal reasoning.

> If the assumption is that the look is going to be "I have to discover" or come up with something on my own, I give them some time to think about it individually, to unfold their ideas on paper, to write them down, and then these same ideas are shared with peers and subjected to agreement. [TE2]

Similarly, an educator points out that this activity promotes the search for consensus among future teachers, allowing the study of curricular aspects specific to the discipline.

> Together, they can build a strategy, and they can validate the strategy. They can say, "This is not right," or "This needs to be modified; I do not think it is right." So, it provokes a discussion among them to generate a favourable case in which they can find a valid strategy to solve the activity. [TE3]

In turn, concerning the knowledge structure dimension, a sophisticated tendency of this belief is also reflected when they reflect on how complex it is to teach the ability to model mathematically in initial teacher training. Theoretically, different proposals have been put forward to address its development, thus recognizing the need for a complex approach that integrates and links knowledge from different perspectives.

> This can be achieved by incorporating different theoretical perspectives, work methodologies, and various frames of reference. Because staying with a single theoretical viewpoint completely

monopolizes the learning process. [TE3]

Another interesting aspect to highlight is the suggestions made by the educators to approach the topics related to the discipline and the factors to consider when putting them into practice in the school context. In this way, they share an integrated vision of knowledge, linking pedagogical, disciplinary, and contextual aspects.

> Apart from these curricular problems, there are socioemotional problems and many variables. They need to remember the educational project, the role of looking at the school's mission and vision for their teaching role, and how students' vulnerability index impacts classroom learning. [TE7]

On the other hand, regarding the teaching strategies they use to work on the modeling skill, the teacher educators warn that the subject is still under discussion, as they have a dynamic and changing view of knowledge.

> I do not have a fixed and well-defined strategy to work on modeling since several approaches and proposals have evolved. [TE1]

This dynamic character of knowledge also arises when pointing out the changes that initial training has faced. Specifically, there is a need to link and work strategically with the different courses, incorporate new assessment criteria, or propose meaningful activities updated to the needs of the context and current knowledge about teaching.

> When I studied, we only had method courses of functions. This has allowed the student not to be focused only on "calculating." I don't know if you understand, as if he was very mathematical in his approach. On the other hand, now, they are seeing reality from another point of view, which leads students to have more tools. [TE3]

In the teacher educators' discourse, aspects related to the dimension of ability to know also emerge, pointing out that it can be developed through experience and learning. To illustrate this point, one trainer emphasizes the need to develop the skills required by future teachers.

> We are not born geniuses; we develop ourselves, and our intelligence develops. Therefore, we all have to work towards it, and teachers are the first to do so. [TE7]

Another teacher educator emphasizes the need to make these processes of change and development explicit regarding what each task implies, and the effort involved in achieving this learning.

> Sometimes, you may be thinking for a long time, and you do not always get to a good end, but in the medium and long term, you will notice the difference... because students are different and have different abilities and rhythms. [TE2]

Finally, sophisticated epistemological beliefs can also be appreciated in the teacher educators' discourse concerning the dimension of speed to know. For example, when addressing the situation presented in the first vignette, the teacher educators point out that the ability to model mathematically is consolidated through different tasks and procedures, imprinting a gradual character in the construction of knowledge.

> I want to tell them that it will take some time, a process of getting used to it, that sometimes it will not be easy, and that we will not finish. [TE2]

In this same context, another teacher educator points out the need to recognize gradualness in the design and planning of the work developed in the programming of each activity, starting with attainable objectives and then advancing in complexity.

> Our students can do what we propose if we do it gradually. They will not achieve a learning objective if we start from analysing, for example, but if we do it gradually, gradually as it should be, they will achieve it. [TE7]

4.2. Epistemological Beliefs and Teaching Practices: Obstacles to Congruence

In the teacher educators' discourse, different obstacles also emerged between their sophisticated epistemological beliefs and the tendency to opt for strategies aligned with these beliefs. First, they perceive themselves as obstacles, as they see their pedagogical decisions are subject to the future

teachers' opinion of their deployment in the context of initial teacher training. This perspective generates tension when adopting decisions that are not coherent with their epistemological beliefs, for example, when they try to generate instances of dialogue and group work.

> We have had cases of professors who try to stop these processes [group work] because of the response given by the students; [they] indicate certain complexities. [TE1]

Faced with this difficulty, some arguments arise that could guide their decision-making in initial teacher training. For example, when the students' tastes or preferences are considered, the focus on learning that should prevail in the formative experience is blurred.

> So, I better go back to the usual what I know that in the end, it is gratifying that two students tell me, "I liked the class," and one says, "Ah! So, this is the way I should do it". So sometimes, like adversity, you know that it works... but since it does not work the way I want it to at first, I prefer to go for the safe place that has been around for many years where the teacher is the main one and continue in that. [TE3]

A second obstacle that emerges in the interviews is the figure of the future teacher as a barrier to implementing teaching strategies focused on students. Specifically, it is a product of the experience in the school context, linked to a traditional teaching approach based on a transmissive logic where their participation in the classroom was relatively passive. This obstacle can be seen in the following quote:

> When they are used to this strategy of "Look, I am telling you that this is called this way, this is the formula, it is done this way, repeat it a certain number of times." When you put them in a different situation, the students themselves put up certain barriers to this process. I have even faced questions like, "Professor, but if you have to teach me this, why do I have to deduce it myself?" [TE1]

As a result of this school experience, the teacher educators also point out that future teachers generally adopt a teaching model inspired by the teachers they had during their school years, the latter being their referents when making pedagogical decisions.

> In general, student teachers are a mirror of the homogenization of secondary education. The traditional work of the teacher says these are the theorems and the procedures, and then they give them a handout where the students "apply" what the teacher tells them. [TE2]

Time appears as a third obstacle in the educators' discourse, connoting it as one of the main barriers. For example, the decision to approach a mathematical construct using modeling skills is presented as a difficulty due to the phases involved, prompting traditional strategies to deal with the same topics in considerably less time. They also consider the time involved in assessing this type of activity.

> Of course, in addition to the fact that preparing activities of this type also requires much time, the next step would be to assess these activities, which is also an issue; assessment is sometimes complex. [TE5]

On the other hand, there is also pressure to go through the topics considered within a module or program. The dynamics in the context of initial teacher training are similar to those in schools, based on narrow but pretentious planning for learning specific skills and content. In this sense, teacher educators opt for repetitive and reproductive strategies.

> When I work in a very traditional way, explaining a property and then the students replicate the same reasoning, it will be very easy for me; it will be swift to optimize time. Time, I think, is the most complex thing for teachers. I believe many of them could make different decisions than the ones they normally make, but since the main thing is time, I must finish the year addressing this content; if I do not make it, I may be evaluated poorly. So, eventually, they make another decision. [TE6]

Finally, a fourth obstacle that emerges is the internal organization of the teacher education programs, where there are two relevant aspects to point out: the curricular planning of the programs and the formative focus of each module or subject. In this sense, a teacher educator points out that there needs to be a better-articulated approach to the discipline's mathematical contents and teaching aspects.

> I think that, at the moment, it is dissonant. Advanced mathematics is seen as disciplinarily

> independent from elementary mathematics. Then, it is seen in the didactics, which is in the third year, and there, we can see which elementary mathematics is involved in advanced mathematics. [TE4]

In contrast, other teacher educators express the need for an institutional approach so that strategies focused on the student are put in initial teacher training. This presupposes promoting agreements within the academic staff so that future teachers notice this tendency in each of the courses and they can dialogue and overcome the different obstacles that arise together.

> When it comes to incorporating methodologies, it cannot be the teacher's effort. It has to have an almost institutional feel to it. A look at the way the team works. It has to be something that cuts across most of the courses. That way, the students do not see it as a rupture. [TE2]

5. Discussion

Mathematics teacher educators maintain developed or sophisticated epistemological beliefs in their discourse in each dimension considered by the multidimensional model of Schommer-Aikins (2004). This result is relevant if we consider that the development of their beliefs affects their teaching practice and the interactions they generate with the different actors in the community. Public policy's intention to install a student-centered teaching approach (CPEIP, 2021) is possibly permeating the discourse of teacher educators.

In addition, different obstacles related to adopting this pedagogical approach were identified, such as how they visualize themselves as educators, the students in training, the time, and the internal organization of the teacher education programs. Regarding these obstacles reported by the teacher educators, several studies with primary and secondary school teachers report similar difficulties in materializing this approach in the school context (Aldossari & Al Khalidi, 2021; Sengul et al., 2020; Sun, 2017). Likely, the autonomous and intuitive nature of their professional insertion in initial teacher training generates this type of difficulty referred to their actions (Kelchtermans et al., 2018). This is a problem when their learning occurs through trial and error (Allen et al., 2016), making it difficult to adequately transition to their new role as a teacher educator (Gómez, 2019; Montenegro, 2016).

Concerning future teachers, Aldossari and Al Khalidi (2021) indicate that the need for more skills to work autonomously, in addition to the shortcomings in the achievement of some learning that students have in the school context, causes teachers to opt for traditional teaching strategies. This argument is repeated almost in a similar way in the discourse of teacher educators, highlighting the need to implement expository teaching practices as a result of the weaknesses they detect in future teachers. As for time, the interviewed educators point out that it constitutes one of the main difficulties in implementing strategies aligned with their epistemological beliefs.

Sengul et al. (2020) and Sun (2017) report similar difficulties that favor opting for traditional practices. According to the results presented by these authors, the accumulative and transmissive logic of the contents, in addition to the evaluative strategies and the competitiveness present in schools, have repercussions as an obstacle to implementing other types of experiences in the classroom. At the level of the teacher education program, the need for articulated work on the mathematical and pedagogical contents of the discipline arise in the teacher educators' discourse. In addition, the possibility of promoting collaborative work as an academic staff is increased, an aspect that is seen as a transversal difficulty in initial teacher education programs (Vaillant & Marcelo, 2021).

6. Limitations and Suggestions for Future Research

First, the findings reported are local and contextual (universities in south-central Chile), based on a small sample (seven teacher educators) and a single type of data (teacher educators' accounts). Therefore, it is recommended to avoid generalization and proceed cautiously in their analysis and interpretation. Second, due to the unpublished nature of the script and the vignettes, it is advisable to review and use this device as a free proposal to be improved and adapted. Moreover, it is

possible that the "snowball" technique may have been biased when choosing the participants; however, the first three educators to be contacted did not know each other, mitigating the scope of this bias.

For the development of future research, it is recommended to go deeper into the challenges faced by teacher educators in mathematics method courses in the university classroom. Specifically, it is suggested that teacher educators pay attention to their speeches, opinions, and suggestions; it is also recommended that they observe their teaching practices and identify strengths, weaknesses, and needs, considering the characteristics of the context where they work. A complex view of this phenomenon could complement the literature's findings and help strengthen mathematics teacher training programs in secondary education.

7. Conclusions

This study aimed to analyse the epistemological beliefs in the discourse of mathematics teacher educators. The findings reported in this work represent an exploratory advance in this field of study, considering the current antecedents at the national and international levels. Nevertheless, developed epistemological beliefs are observed in the discourse of mathematics teacher educators. Therefore, they are aligned with the didactic pedagogical turn proposed by the new public policy.

On the other hand, in the discourse of teacher educators some obstacles or barriers prevent coherence between their developed epistemological beliefs and the use of student-centered teaching strategies within the teacher education programs for mathematics teachers in secondary education. This constitutes a double problem for the training programs: first, it could limit the learning of future teachers, and second, it could model a traditional teaching style that future teachers would later replicate once they are inserted in the school context.

As a recommendation, spaces for dialogue and reflection within the academic staff through learning communities should be implemented to promote the analysis of epistemological beliefs and encourage discussion around the teaching practices generally used in initial teacher training. It is also recommended to advance collectively in reviewing and detecting some characteristics of the context that may be an obstacle to implementing student-centered pedagogical strategies.

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Data availability: The data generated and analyzed during this study are available from the authors upon request.

Declaration of interest: The authors declare no conflict of interest.

Ethical statement: All participants provided informed consent by national ethical standards before participating in the study. They were informed about the study's purpose, procedures, and their right to withdraw at any time without consequence.

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